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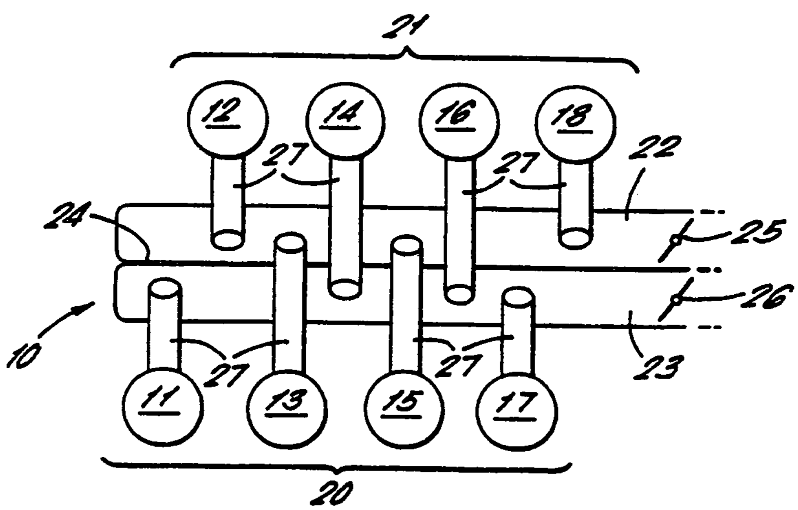

(57) Abstract

The present invention provides in all aspects an intake manifold (10) for an internal combustion engine having a plenum (22) to be filled with combustible charge and inlet passage means (27) serving in use of the manifold (10) to connect the plenum (22, 23) with a cylinder (11 to 18) of the engine. In a first aspect of the invention the intake manifold has first and second plena (22, 23) and the inlet passage means (27) connect each plenum (22, 23) with a cylinder (11 to 18) of the engine such that combustion chamber means of the engine which fire consecutively are respectively supplied with combustible charge from a different plenum (22, 23). In a second aspect of the invention the manifold (10) has inlet passage means (27) comprising wall means (46) dividing at least a part of the inlet passage means (27) into a plurality of paths (44, 45) for fluid flow, and valve means (47) operable to open and close at least one of said paths (44, 45). In a third aspect, the invention provides an inlet manifold having a first and second plena (68, 69) each supplying a different plurality of cylinders of an engine and plena connecting means (60, 61, 62) operable to connect first (68) and second (69) plena to allow all of the cylinders (71 to 78) of the engine (90) to receive charge from both plena (68, 69) and to allow the resonant frequency of the intake manifold to be altered.

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INTAKE MANIFOLD FOR A MULTI-CYLINDER INTERNAL COMBUSTION ENGINE

This invention relates to an intake manifold for a multi-cylinder internal combustion engine. In particular, although not exclusively, the invention relates to an intake manifold for a V-configuration spark ignition engine having a four stroke cycle and to such an intake manifold for use in an engine having a horizontally opposed configuration.

V8 and V12 engines have for a number of years been popular in motor cars requiring large engine outputs since their dynamic balance and torque characteristics are favourable for road vehicle use.

However, V8 and V12 engines are difficult to design as compact units for various reasons, including the problem that large crankcase castings are required to accommodate the cruciform crankshafts almost exclusively used in V8-configuration engines. There therefore exists a general need to reduce the overall dimensions of V-configuration engines, especially in the light of recent development work on light weight, high output V8 and V12 engines utilising relatively small swept volumes. Such reductions would be facilitated if the overall dimensions of parts such as intake manifolds could be reduced.

In general the prior art V8 and V12 engines (and other engines with banks of cylinders) have tended to use an intake manifold with one plenum situated between the banks to supply both banks. Alternatively separate manifolds are used for each bank of cylinders.

A disadvantage of previous intake manifolds for V-configuration and horizontally opposed engines is that adjacent cylinders of the engine are conventionally connected to the plenum of the intake manifold by correspondingly adjacent intake tracts. If the cylinder

firing order of the engine requires two adjacent cylinders to fire consecutively the second such cylinder to fire receives a reduced charge of combustible material due to localised depletion of the plenum by the first such cylinder to fire. The volumetric efficiency of the engine is thereby reduced. By "adjacent" in this context is meant both adjacent in an axial direction of the engine along a bank of cylinders, and adjacent in a transverse direction of the engine from one cylinder bank to the other.

According to a first aspect of the invention there is provided a multi-cylinder internal combustion engine intake manifold comprising first and second plena to be filled with combustible charge; and inlet passage means to connect each plenum with a cylinder of the engine wherein combustion chamber means of the engine which fire consecutively are respectively supplied with combustible charge from different plena.

An advantage of this arrangement is that the problem of charge depletion in the second to fire of two adjacent, consecutively firing cylinders is eliminated. A further advantage of this arrangement is that the two plena may be disposed so as to minimise the overall dimensions of the engine.

In preferred embodiments of the invention the intake manifold is adapted for use by an engine having a plurality of banks of cylinders, each plenum being connectable to cylinders from both banks.

Preferably the intake manifold comprises source means for supplying combustible charge to the plena, the first and second plena being respectively supplied with combustible charge from differing source means. The source means may be, for example, a pair of carburettors, a pair of throttles having a kind of fuel injection system known as a port fuel injection (PFI), a pair of throttles having a kind of

fuel injection system known as throttle body fuel injection (TBI) or a pair of throttles having a fuel injection system which is a combination of the PFI and TBI kinds and these and similar arrangements advantageously ensure the elimination of charge depletion as described above.

It is further preferable that the first plenum is disposed generally above the second plenum in a single unit. An advantage of this configuration is that the overall dimensions of the intake manifold may be small and compact and the manifold can be manufactured as either an integral item or in two pieces. Additionally, the inlet passages interconnecting the engine cylinders and the plena can be arranged to be all of the same length and this is a desirable feature in internal combustion engines.

Conveniently with a manifold for use with an internal combustion engine of V8 configuration, in use the first and fourth numbered cylinders of the right hand cylinder bank of the engine and the second and third cylinders of the left hand cylinder bank are supplied with combustible charge from the first plenum, and the remaining cylinders are supplied with combustible charge from the second plenum, the cylinders of each bank of the engine being numbered consecutively from the front of the engine.

With a manifold for use with an internal combustion engine of V12 configuration, preferably in use all the cylinders of the right hand cylinder bank of the engine are supplied with combustible charge from the first plenum and all the cylinders of the left hand cylinder bank of the engine are supplied with combustible charge from the second plenum.

The above arrangements advantageously ensure that, for the conventionally adopted firing orders of most V8 and V12 engines, charge depletion in consecutively firing cylinders is reduced.

A further problem of conventional intake manifolds employed in internal combustion engines is associated with the dynamic characteristics of the inlet passages interconnecting the plenum of an intake manifold and the combustion chambers served by that manifold.

Such passages are designed to have a resonant natural frequency corresponding to a compromise speed at which, by virtue of the overall design of the vehicle in which the engine is installed, it is hoped that the engine will run.

It is well known that resonance in the intake manifold of an internal combustion engine causes a beneficial effect known as inertial charging, in which the combustible charge is compressed to a degree prior to its entry into the combustion chamber. Volumetric efficiency of the engine is thereby improved as a result of inertial charging, but it is clear that all the inlet passages of an engine must have equal lengths to provide even running of the engine.

Clearly the tuning of inlet passages to a single resonant frequency only provides optimum inertial charging at a single speed, or at best a very narrow range of speeds.

A system which provides a plurality of resonant frequencies in an inlet manifold is described in GB 2174454. The system comprises a manifold having one plenum which can be connected to a cylinder of the engine by two different routes of different lengths, the route of shorter length being selected for higher engine speeds.

According to a second aspect of the invention, there is provided an internal combustion engine intake manifold comprising a plenum to be filled with combustible charge; inlet passage means to interconnect the plenum and a cylinder of the engine; and means for selectively varying the geometry of the inlet passage means thereby to alter its natural frequency, wherein the means for selectively

varying the ratio of the cross-sectional area to the length of the inlet passage means comprises wall means dividing at least a part of the inlet passage means into a plurality of paths for fluid flow, and valve means arranged selectively to open and close at least one of said paths thereby selectively varying the ratio of the cross sectional area to the length of the inlet passage means open to flow of fluid.

An advantage of using a variable geometry of the inlet passage means is that the resonant frequency of the intake manifold can be altered. The abovedescribed embodiment of the invention does this by varying the area of the inlet passage means rather than the length of the inlet passage means as is done in GB 2174454.

Preferably the valve means comprises a throttle plate disposed in a path for fluid flow, said throttle plate having a periphery conforming to the cross sectional shape of the path and being pivotable between an open position in which the throttle plate is aligned generally parallel with the flow of fluid along the path and a closed position in which the throttle plate is aligned generally perpendicular to the flow of fluid along the path, thereby to prevent such flow.

Preferably an engine management system is provided for controlling the valve means in the inlet passage means, which engine management system opens the valve means at a chosen engine speed or when the engine management system detects a decrease in the output torque of the engine with increasing speed.

According to a third aspect of the invention, the present invention provides an intake manifold for a multi-cylinder engine comprising first and second plena to be filled with combustible charge, said plena each being connected via inlet passage means to a different plurality of cylinders of the engine, wherein there is provided plena connecting means operable to connect and disconnect

said first and second plena, whereby the two plena can be connected to both supply both pluralities of cylinders and whereby the resonant frequency of the intake manifold can be altered.

This advantageously provides two natural frequencies to which the inlet passage means may selectively be tuned. These natural frequencies may be designed to correspond respectively to typical slow speed operation of the engine (as occurs for example, during economical motorway cruising in a motor car) and typical high speed operation of the engine (as occurs, for example, when a motor vehicle is driven fast on non-motorway types of road).

Preferably an engine management system is provided for controlling the plena connecting means, which engine management system controls the plena connecting means to connect the first and second plena at a chosen rotational speed of the engine or when the engine management system detects a decrease in the output torque of the engine with increasing engine speed.

Preferably the intake manifold is provided in a multicylinder internal combustion engine which has a plurality of cylinders in line in a cylinder block and the first and second plena both extend along the length of the cylinder block each having first and second ends spaced apart in the longitudinal direction of the cylinder block, wherein charge is supplied to the plena at first ends thereof and the plena connecting means is provided at the second ends thereof, the plena each being connected by the inlet passage means to the cylinders of the engine at points spaced along the plena between the first and second ends.

Preferably there is provided in all embodiments of the invention means for selectively varying the ratio of the cross-sectional area to the length of the inlet passage means, which means comprises flap means

selectively movable in said inlet passage means between a first sealing position and a second sealing position; and means for selectively moving said flap means between the first and second sealing positions, wherein, when the flap occupies the first sealing position first path for fluid flow exists between the plenum and a cylinder of the engine, and when the flap means occupies the second sealing position a second shorter path for fluid flow exists between the plenum and a cylinder of the engine.

Conveniently, when the flap means occupies its second sealing position, a portion of the first path for fluid flow is bypassed.

This arrangement when used can be used to advantageously provide for the selective tuning of the inlet passage means to a further two natural frequencies if it is used in conjunction with the alternative arrangements for tuning the inlet passage means referred to above. By combining the turning arrangements of the invention mentioned above it is possible to provide an intake manifold having inlet passage means selectively tunable to up to four or eight different natural frequencies, corresponding to four or eight frequently used engine speeds.

There now follows a description of three embodiments of the invention, by way of example, with reference being made throughout to the drawings in which:

Figure 1 is a diagrammatic representation of a V8 configuration internal combustion engine intake manifold according to the invention;

Figure 2 is a diagrammatic representation of a V12 configuration internal combustion engine intake manifold according to the invention;

Figure 3 is a cutaway plan view of part of the intake manifold of Figure 1 or Figure 2;

Figure 4 is a transverse cross-sectional view on

line 4-4 of Figure 3; and

Figure 5 is a transverse cross-sectional view on line 5-5 of Figure 3.

Figure 6 is a plan cross-section of a second intake manifold for a V8 configuration internal combustion engine intake manifold according to the invention.

Figure 7 is an exploded projection view of the engine intake manifold shown in Figure 6.

Figure 8 is a transverse cross-section view of the embodiment shown in Figures 6 and 7, taken along the line A-A.

Figure 9 is a transverse cross-sectional view of the embodiment of Figures 6 to 8 in use with a V8 configuration engine.

Referring firstly to Figure 1 there is shown a V8 configuration, internal combustion engine intake manifold 10 which supplies combustible charge to a left bank 20 and a right bank 21 of cylinders having valve gear and combustion chambers of known types. The cylinders are numbered consecutively from 11 to 18 inclusive, with cylinder 11 being the left hand front cylinder, cylinder 12 being the right hand front cylinder and so on to cylinder 18, which is the right hand rear cylinder.

Intake manifold 10 has upper and lower plena 22 and 23 which are divided from one another by a wall 24. Each plenum is respectively supplied with combustible charge from a source such as a pair carburettors or throttle bodies (not shown) respectively supplying to the rearward ends of the plena as drawn. The flow of combustible charge is regulated in each plenum 22, 23 by corresponding butterfly valves 25 and 26 located towards the rear of the plena. The two plena are therefore supplied with combustible charge from differing source means.

Each plenum 22, 23 of Figure 1 supplies four of the eight cylinders of the V8 configuration engine with combustible charge via an arrangement of inlet passages 27.

The upper plenum supplies cylinders 12 and 18 of the right hand cylinder bank 21 and cylinders 14 and 16 of the left hand cylinder bank 20; the remaining cylinders are supplied with combustible charge from lower plenum 23. This is because the firing order of the cylinders of the engine of Figure 1 is 11, 18, 14, 13, 16, 15, 17, 12 and to avoid the undesirable effects of charge depletion referred to above it is necessary that cylinders 13 and 14 are fed from different plena; that cylinders 16 and 15 are fed from different plena; and that cylinders 15 and 17 are fed from different plena. However, from the point of view of balancing the demands on the two plena 22 and 23 it is desirable that each plenum supplies four cylinders with combustible charge.

The firing order given above is the most common firing order for V8 configuration engines and the apparatus of Figure 1 therefore constitues a multi-cylinder internal combustion engine intake manifold comprising first and second plena to be filled with combustible charge; and inlet passage means to interconnect each plenum and a cylinder of the engine, combustion chamber means of the engine which fire consecutively being respectively supplied with combustible charge from differing plena.

It should be noted that Figure 1 is diagrammatic, and in reality the inlet passages 27 are all of equal length and cross-sectional area.

Referring to Figure 2 there is shown an intake manifold 10 adapated to supply the cylinders 31 to 42 of an internal combustion engine having a V12 configuration.

In Figure 2 like reference numerals represent corresponding parts to those shown in Figure 1 and a similar numbering convention for the cylinders 31 to 42 is adopted as for cylinders 11 to 18 in Figure 1.

Since the firing order of cylinders of the engine of Figure 2 is 31, 42, 39, 34, 35, 38, 41, 32, 33, 40, 37,

36, adjacent, consecutively firing cylinders only occur within the same bank of cylinders as each other, and it is therefore possible for each plenum 22, 23 to supply, via passages 27 all of equal length and cross-sectional area, one bank 20, 21 of cylinders. As shown, upper plenum 22 supplies right bank 21 and lower plenum 23 supplies left bank 20, although the alternative arrangement is possible. The design of intake manifold 10 is therefore slightly simpler for a V12 configuration engine than for a V8 configuration engine.

Referring to Figures 3 to 5, there is shown in detail a portion of the intake manifold of the invention shown schematically in Figure 1 or 2.

As shown in the drawings, the plena are connected to respective cylinders of the engine via inlet passages 27. The valve gear of some of the cylinders in the vicinity of Figure 3 is shown in dotted lines and is denoted generally by the numeral 28.

Each inlet passage is divided into two parallel paths 44 and 45 of generally equal cross sectional area and length by a longitudinal dividing wall 46. Each dividing wall 46 extends from a point adjacent the plenum to which the passage 27 in question is connected to the end of the passage and is such that combustible charge flowing into the passage 27 has a choice of two substantially identical flow paths if each path 44, 45 is fully open to fluid flow.

The path 45 of each passage 27 is continuous and offers a permanently free route between a plenum such as plenum 22 and a corresponding cylinder.

The path 44 of each passage 27 however, includes disposed at its end adjacent the cylinder a throttle plate 47 pivotally mounted on a shaft 48 and linked to a control mechanism (not shown) selectively opening and closing the throttle plate 47 in a manner to be described below. This arrangement provides the capability of selectively opening

and closing the path 44 of each passage and therefore constitutes means for selectively varying the ratio of the cross-sectional area to the length of the inlet tract means. The lengths L of the paths 44, 45 between the free end of dividing wall 46 and the cylinder are substantially identical.

At the end of each passage 27 adjacent the respective plenum to which it is connected there is provided a switchable fluid guide plate 49 which is shaped to be of the same cross-section as the region of passage 27 in which it is located, and which is pivotable at its lower end about a shaft 50 under the control of a control mechanism (not shown) between first and second sealing fluid directing positions.

In its first position, the guide plate 49 occupies the position shown in dotted lines and as shown in Figures 4 and 5 is profiled to direct the flow of combustible charge from the relevant plenum via a long path for fluid flow incorporating path loop 52 in Figure 4 and path loop 53 in Figure 5.

In its second sealing position, the guide plate 49 occupies the position shown in solid lines in Figures 4 and 5 and directs combustible charge from the relevant plenum via a relatively short path for fluid flow, by bypassing the loops 52 or 53 (as appropriate).

The sense in which the guide plates 49 occupy "sealing positions" is that when either the long or short path for fluid flow is closed, such closure is effected by the guide plate 49 sealing substantially entirely against the inner wall of the inlet passage 27, thereby cutting off flow through one of the paths.

The pivot shaft 50 of the guide plates 49 located on the same side of the intake 10 extends along the length therof, as best shown in Figure 3, and therefore operate to control the guide plates 49 of their respective sides of the intake manifold 10 simultaneously.

At low engine speeds, each guide plate 49 of the embodiment shown in Figures 1, 3, 4 and 5 occupies its first position as described above, and the throttle plates 47 of the paths 44 are closed. The combustible charge is therefore fed to the cylinders from the plenum via a relatively long path of relatively small cross-sectional area.

As the engine speed rises, the guide plates 49 move under the influence of the control mechanism to occupy their second sealing positions, and the length of the inlet passages relative to their areas is thereby reduced, increasing optimum engine speed from the point of view of inertial charging by changing the natural frequency of the intake passage.

If the engine speed increases still further, the throttle plates 47 open under the influence of their control mechanisms, thereby increasing the available cross-sectional area of the inlet passages 27 and raising the natural frequencies thereof still further.

By this method, optimal inertial charging effects can be obtained at three engine speeds, instead of one as was previously available. A fourth optimal engine speed could also be produced by opening the throttle plates 47 while the guide plates 49 occupy their first positions as described herein.

A great variety of control schemes for the throttle plates 47 and fluid guide plates 49 is possible. It has been found that the intake manifold is particularly suitable for control by an electronic engine management scheme which can operate actuators which in turn operate the plates 47 and guides 49 via mechanical linkages. Engine management schemes which may readily be adapted for this purpose are now commonplace in motor vehicle engines.

It is preferable to alter the tuning of the inlet manifold and alter its natural frequency as the output torque of the engine begins to drop with increasing engine

speed. The optimum engine speeds for change of manifold tuning can be calculated and the engine management system can be programmed to control the guide plates 49 and throttle plates 47 accordingly.

Alternatively the engine management system could be adpated to sense when the output torque of the engine decreases with increasing engine speed and control the tuning of the inlet manifold accordingly. The engine management system would be preferably set up to provide optimum torque output throughout a wide spread of engine speeds.

A further embodiment of an engine intake manifold according to the present invention is shown in Figures 6 to 9. The embodiment shown is a V8 configuration manifold.

In the embodiment of Figure 6 two plenums 68 and 69 are located side by side in the same horizontal plane. They can be connected by a passage 60. A valve member 61 is located in the passage 60 and can be rotated by a rotatable shaft 62 which is journalled in the end cover 59. The shaft 62 is attached to a motor (not shown) which is controlled by an engine management system

It can be clearly seen in Figure 8 that the engine intake manifold is a two piece component. The plenums 68 and 69 are provided by a single component 63 and the manifold intake passages by a component 64. Both components are provided with flanges 65, 66 which enable sealing engagement of the components. Two throttles 80 and 81 are provided in a throttle body 67 attached to the plenum component 63 and the valve 61 is provided on the end cover 59 for the end of plenum component 63.

The components 64 and 63 are preferably either plastic mouldings or aluminium castings.

In Figure 6 the diagram shows outlets 71 to 78 for respective engine cylinders (not shown). The firing order for the cylinders is chosen such that charge is drawn from the outlets in the order 71- 72- 77- 78- 76- 73- 74- 75.

This solves the problem of charge robbing as previously discussed.

The internal structure of the manifold of Figures 6 and 7 is shown in Figure 8, which is a transverse cross-section taken through the lines A-A in Figure 6.

The manifold can be seen in use in Figure 9 as part of a V8 configuration engine 90.

The intake manifold of the embodiment illustrated in Figures 6 to 9 provides the possibility of intake manifold tuning with speed by provision of the valve 61. An engine management system can be used to open the valve 61 to link the plenums 68 and 69. At low engine speeds the valve 61 will typically seal off plenums 68 and 69 so that both operate independently. At high engine speeds the valve 61 will be opened so that both plenums are linked to form, in effect, one large plenum. This has a de-tuning effect and results in improved engine performance and power output at high engine speeds.

The valve 61 is preferably controlled to separate the two plena at low engine speeds below. When the torque produced by the engine decreases with increasing engine speed, then the engine management system links the two plena at higher engine speeds to detune (alter the natural frequency of) the intake manifold.

The valve 61 of the embodiment shown in Figures 6 to 9 can be used on its own (as shown in the figures) to vary inlet manifold tuning or could be used with the flap valve 49 in a system wherein the intake manifold has a wall 46 in each outlet with a valve 47. In a suitably arranged system (i.e. with one plenum one above the other) the valve 61 should be used in conjunction with the guide plate 49. Indeed the valve 61 could be used in an arrangement with valve 47 and guide plate 49.

It should be appreciated that the valve 61 of the embodiment of Figure 6 to 9, the valve 47 of the embodiment of Figures 3 to 5 and the guide plate 49 of the

embodiment figures 3 to 5 could all be used in manifolds not adapted to provide charge from separate plena to consecutively firing cylinders.

In use, the intake manifolds described in the preferred embodiment eliminate the charge depletion effects of consecutively firing, adjacent cylinders as referred to above.

Further the cross-sectional area to length ratio of the inlet passages can be varied to provide optimum inertial charging at a variety of engine speeds.

The specially configured intake manifold of the embodiments can be used without the valve 61, the guide plate 49 or the valve 47, still providing advantageously a solution to the problem of charge robbing. With the two plena arranged one above the other (Figures 4 and 5) considerable space saving is also achieved.

Finally, whilst the invention is described herein as adapted to operate in conjunction with particular firing orders of particular V-configuration engines, it should be realised that the intake manifolds of all embodiments of the invention can be adapted to operate with a variety of types of engine, includng horizontally opposed engines, having various firing orders of the cylinders.

CLAIMS

1. An intake manifold for a multi-cylinder internal combustion engine comprising first and second plena to be filled with combustible charge; and inlet passage means serving in use of the manifold to connect each plenum with a cylinder of an engine such that combustion chamber means of the engine which fire consecutively are respectively supplied with combustible charge from a different plenum.

2. An intake manifold as claimed in Claim 1 wherein the intake manifold is adapted for use by an engine having a plurality of banks of cylinders, each plenum being connectable to cylinders from both banks.

3. An intake manifold according to Claim 1 or Claim 2 comprising source means for supplying combustible charge to the plena, the first and second plena being respectively supplied with combustible charge from differing source means.

4. An intake manifold according to any one of the preceding claims, wherein the first plenum is disposed generally above the second plenum in a single unit.

5. An intake manifold according to any one of the preceding claim, for use with an internal combustion engine of V8 configuration, in which in use the first and fourth numbered cylinders of the right hand cylinder bank of the engine and the second and third numbered cylinders of the left hand cylinder bank are supplied with combustible charge from the first plenum, and the remaining cylinders are supplied with combustible charge from the second plenum, the cylinders of each bank of the engine being numbered consecutively from the front of the engine.

6. An intake manifold according to any one of Claims 1 to 4, for use with an internal combustion engine of V12 configuration, in which in use all the cylinders of the right hand cylinder bank of the engine are supplied with combustible charge from the first plenum and all the cylinders of the left hand cylinder bank of the engine are supplied with combustible charge from the second plenum.

7. An intake manifold for an internal combustion engine comprising a plenum to be filled with combustible charge; inlet passage means serving in use of the manifold to interconnect the plenum and a cylinder of an engine; and means for selectively varying the geometry of the inlet passage means thereby to alter its natural frequency, wherein the means for selectively varying the geometry of the inlet passage means comprises wall means dividing at least a part of the inlet passage means into a plurality of paths for fluid flow, and valve means operable to open and close at least one of said paths.

8. An intake manifold according to Claim 9 wherein the valve means comprises a throttle plate disposed in a path for fluid flow, said throttle plate having a periphery conforming to the cross sectional shape of the path and being pivotable between an open position in which the throttle plate is aligned generally parallel with the flow of fluid along the path and a closed position in which the throttle plate is aligned generally perpendicular to the flow of fluid along the path, thereby to prevent such flow.

9. An intake manifold as claimed in Claim 7 or Claim 8 adapted for use in a multi-cylinder internal combustion engine comprising first and second plena to be filled with combustible charge wherein the inlet passageway means serve in use of the engine to connect each plenum with a cylinder of the engine such that combustion chamber means

of the engine which fire consecutively in adjacent cylinders are respectively supplied with combustible charge from different plena.

10. A multi-cylinder internal combustion engine having an inlet manifold as claimed in any one of Claims 7, 8 or 9 and having an engine management system for controlling the valve means in the inlet passage means, which engine management system opens the valve means at a chosen engine speed or when the engine management system detects a decrease in the output torque of the engine with increasing engine speed.

11. An intake manifold for a multi-cylinder engine comprising first and second plena to be filled with combustible charge, said plena each being connected via inlet passage means to a different plurality of cylinders of the engine, wherein there is provided plena connecting means operable to connect and disconnect said first and second plena, whereby the two plena can be connected to both supply both pluralities of cylinders and whereby the resonant frequency of the intake manifold can be altered.

12. A multi-cylinder internal combustion engine having an intake manifold as claimed in Claim 11 and having an engine management system for controlling the plena connecting means, which engine management controls the plena connecting means to connect the first and second plena at a chosen rotational speed of the engine or when the engine management system detects a decrease in the output torque of the engine with increasing engine speed.

13. A multi-cylinder internal combustion engine as claimed in Claim 12 or having an intake manifold as claimed in Claim 11 which has a plurality of cylinders in

a line in a cylinder block wherein the first and second plena both extend along the length of the cylinder block each having first and second ends spaced apart in the longitudinal direction of the cylinder block, wherein charge is supplied to the plena at the first ends thereof and the plena connecting means is provided at the second ends thereof, the plena being connected by the inlet passage means to the cylinders of the engine at point spaced along the plena between the first and second ends.

14. An intake manifold as claimed in Claim 11 wherein there is provided means for selectively varying the ratio of the cross-sectional area to the length of the inlet passage means which comprises wall means dividing at least a part of the inlet passage means into a plurality of paths for fluid flow, said paths being of substantially identical length; and valve means arranged selectively to open and close at least one of said paths thereby selectively varying the ratio of the cross sectional area to the length of the inlet passage means open to flow of fluid.

15. An intake manifold for an internal combustion engine as claimed in any one of the Claims 1, 7, 11 or 14 comprising means for selectively varying the ratio of the cross-sectional area to the length of the inlet passage means, which means comprises flap means selectively movable in said inlet passage means between a first sealing position and a second sealing position; and means for selectively moving said flap means between the first and second sealing positions, wherein, when the flap occupies the first sealing position a first path for fluid flow exists between the plenum and a cylinder of the engine, and when the flap means occupies the second sealing position a second shorter path for fluid flow exists between the plenum and a cylinder of the engine.

16. An intake manifold according to Claim 14, wherein, when the flap means occupies the second sealing position, a portion of the first path for fluid flow is bypassed.

17. An intake manifold generally as herein described, with reference to and as illustrated in the drawings.

FIG. 1.

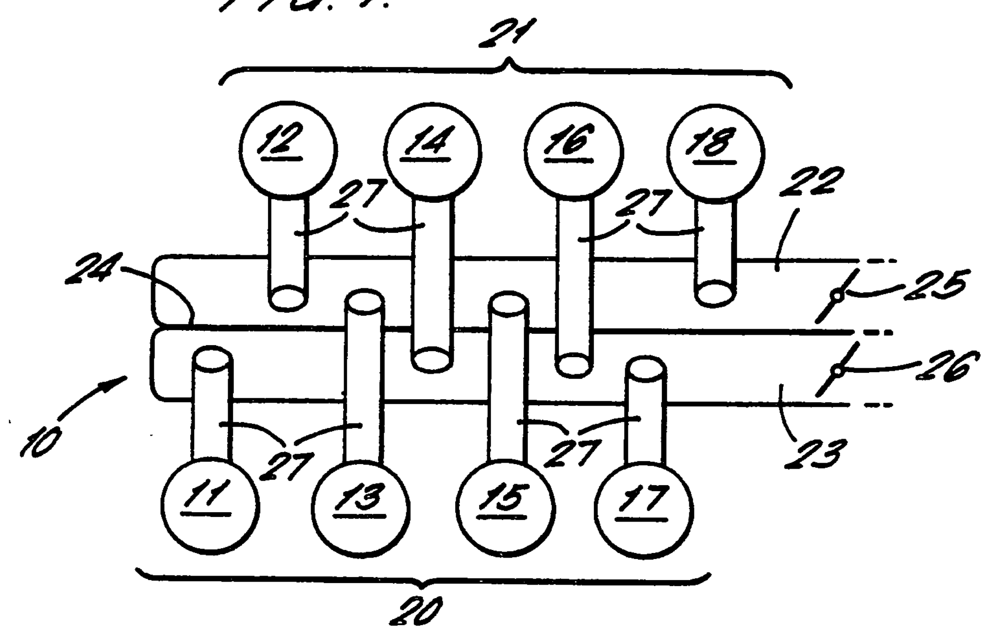
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FIG. 2.

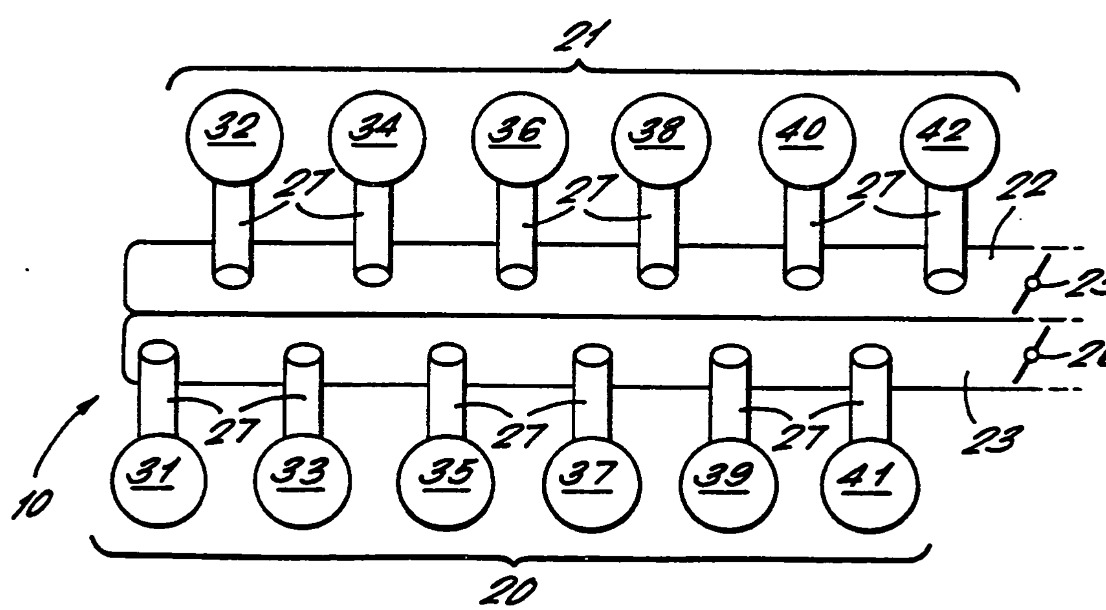
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FIG. 3.

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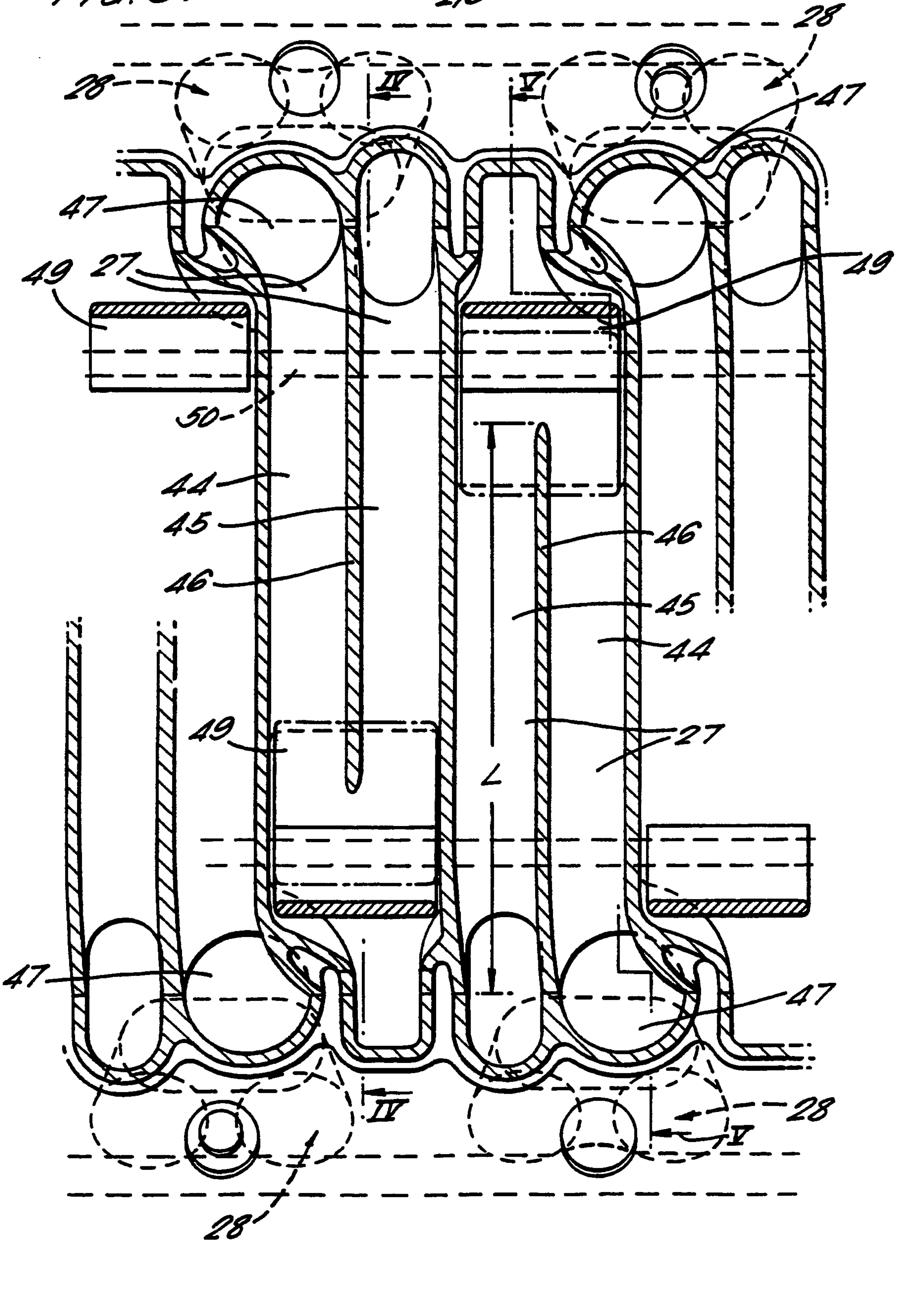

FIG. 4.

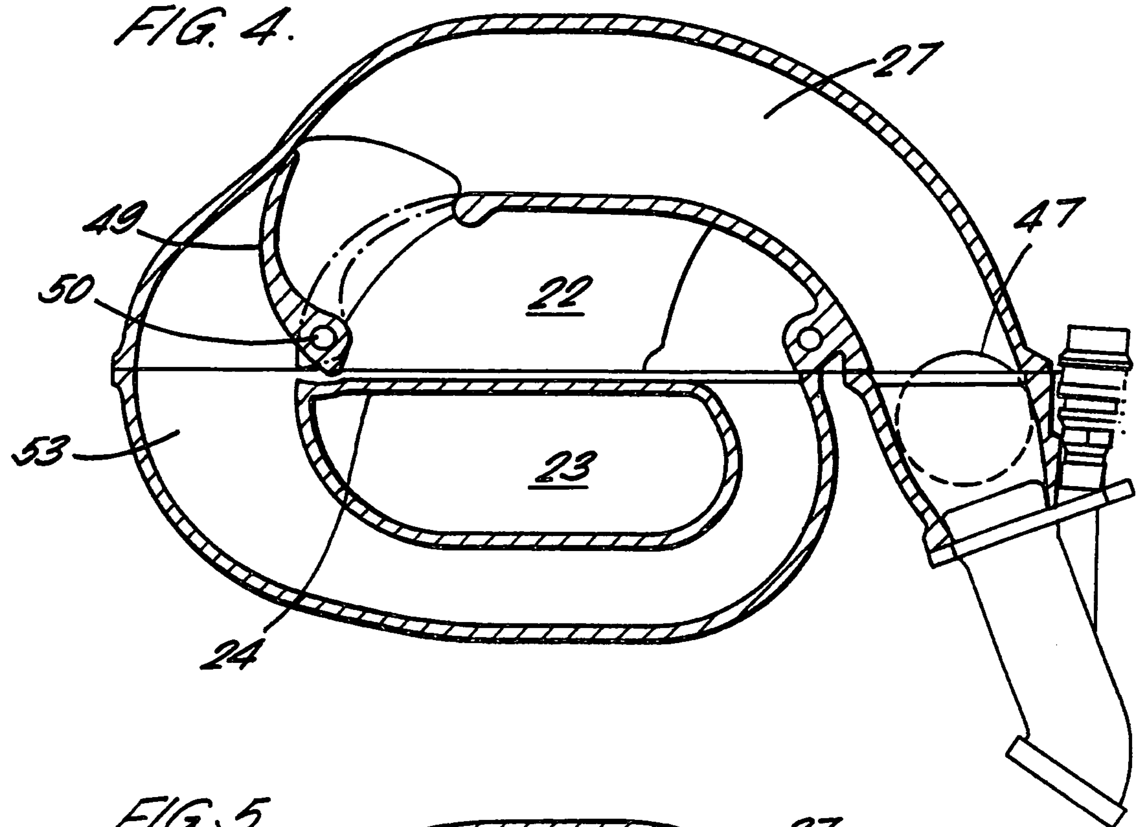

FIG. 5.

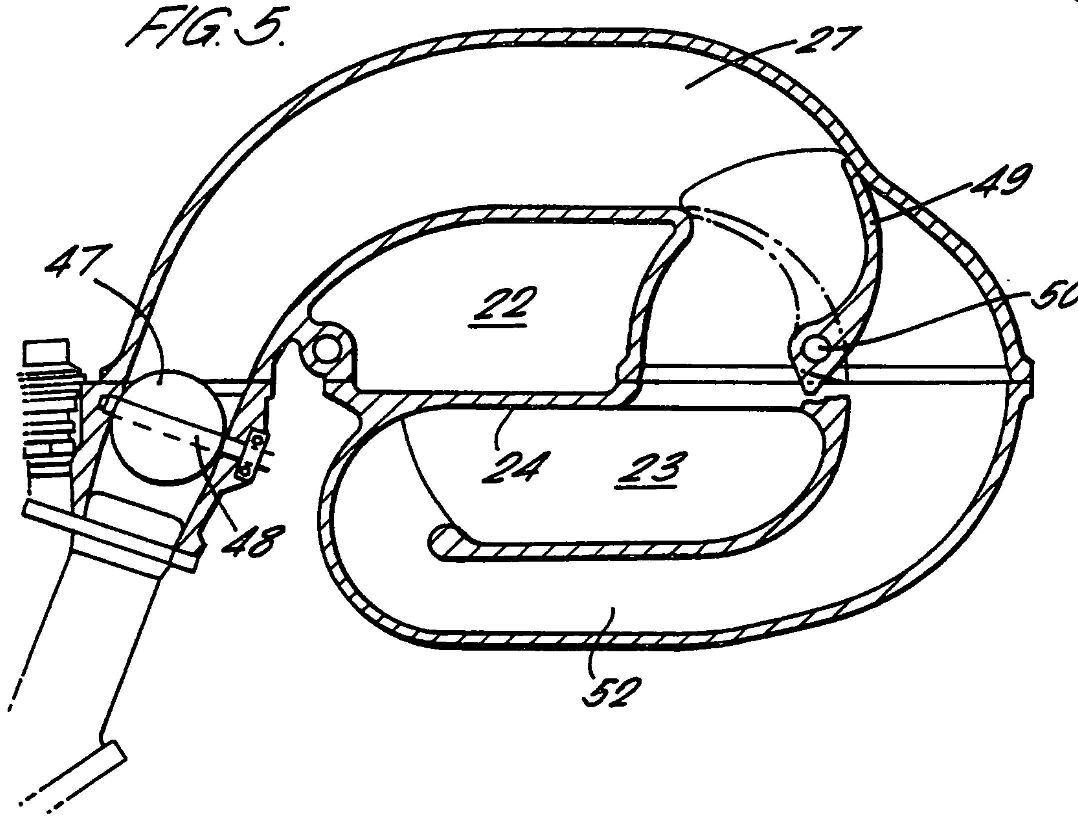

FIG. 6.

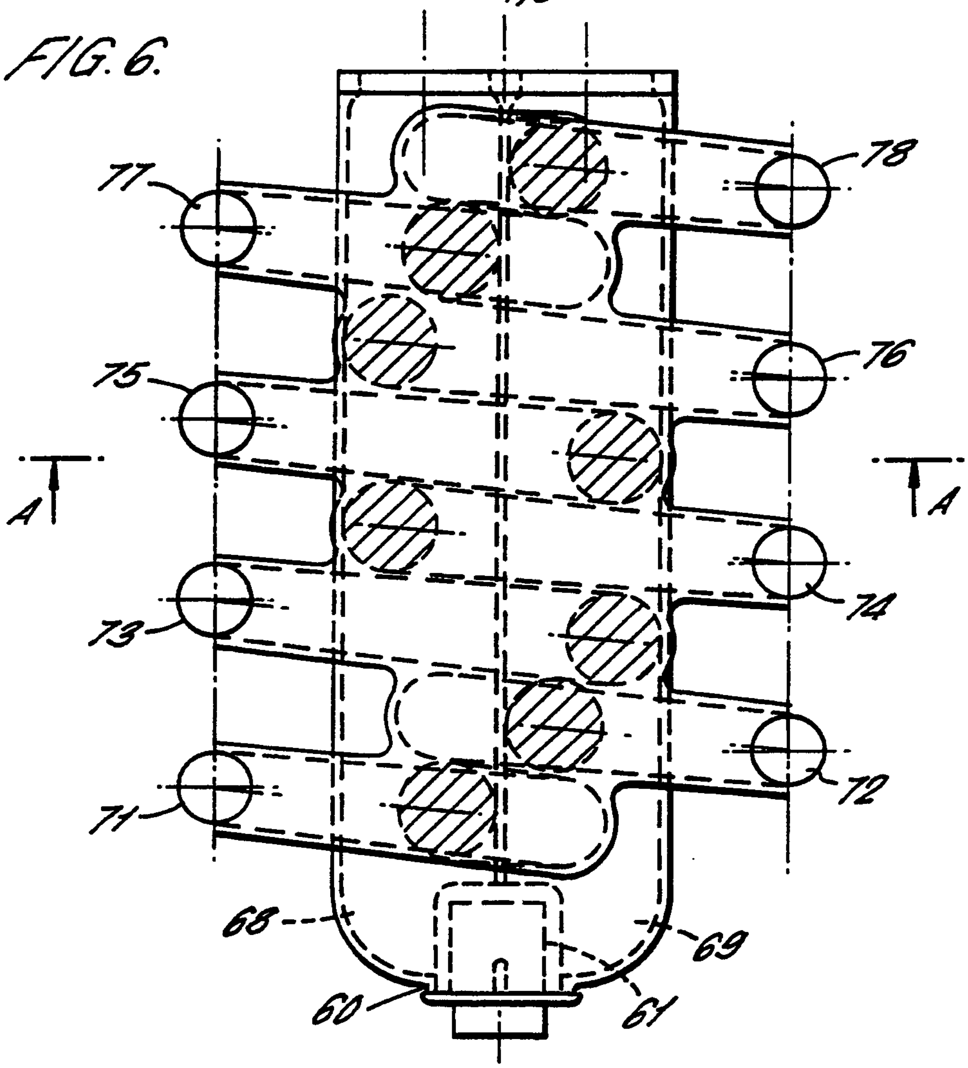

FIG. 8.

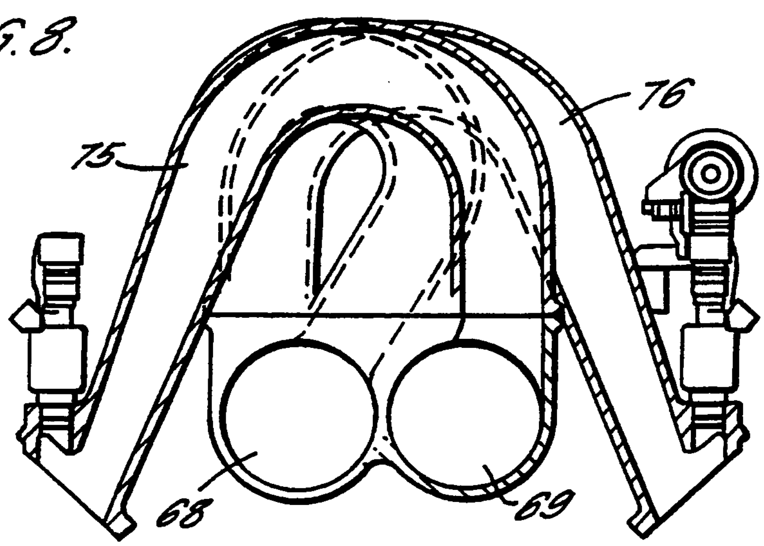

FIG. 7.

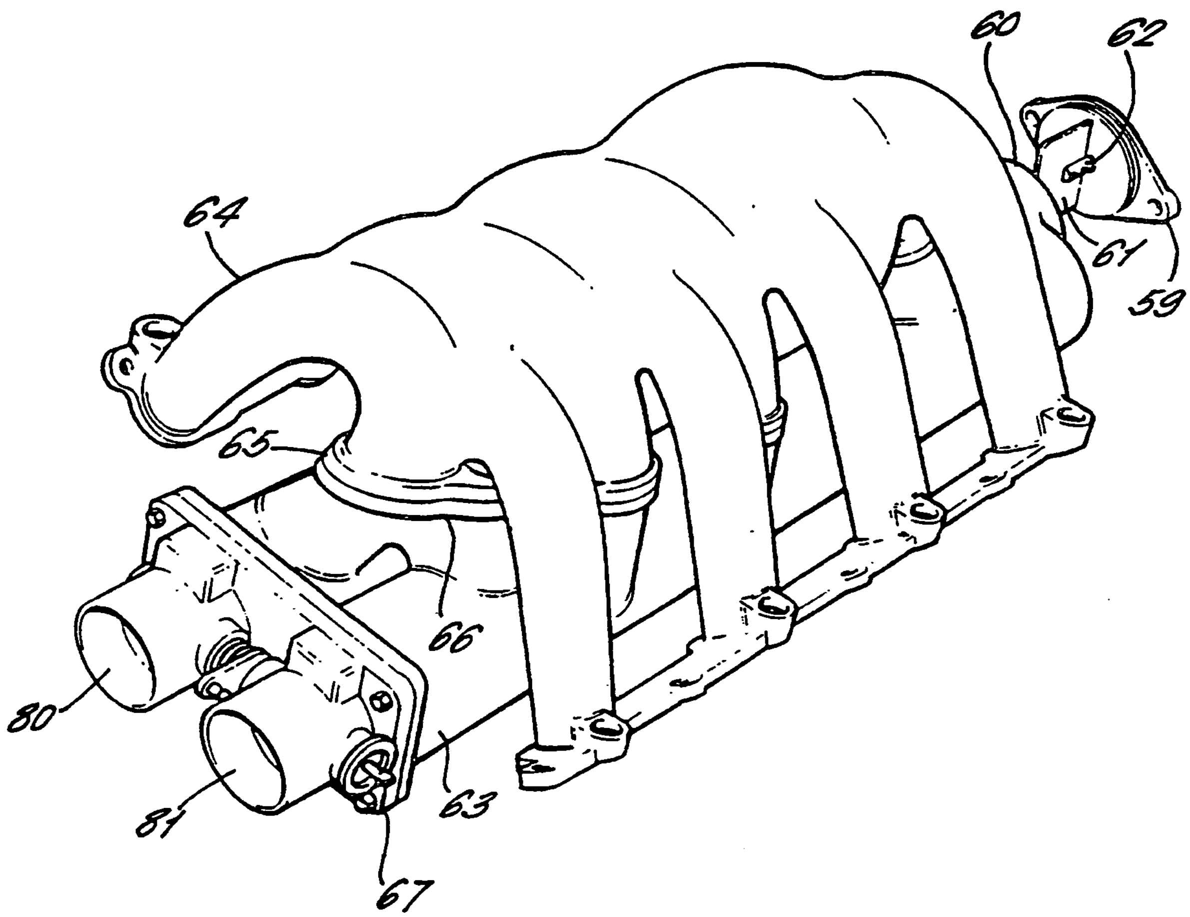

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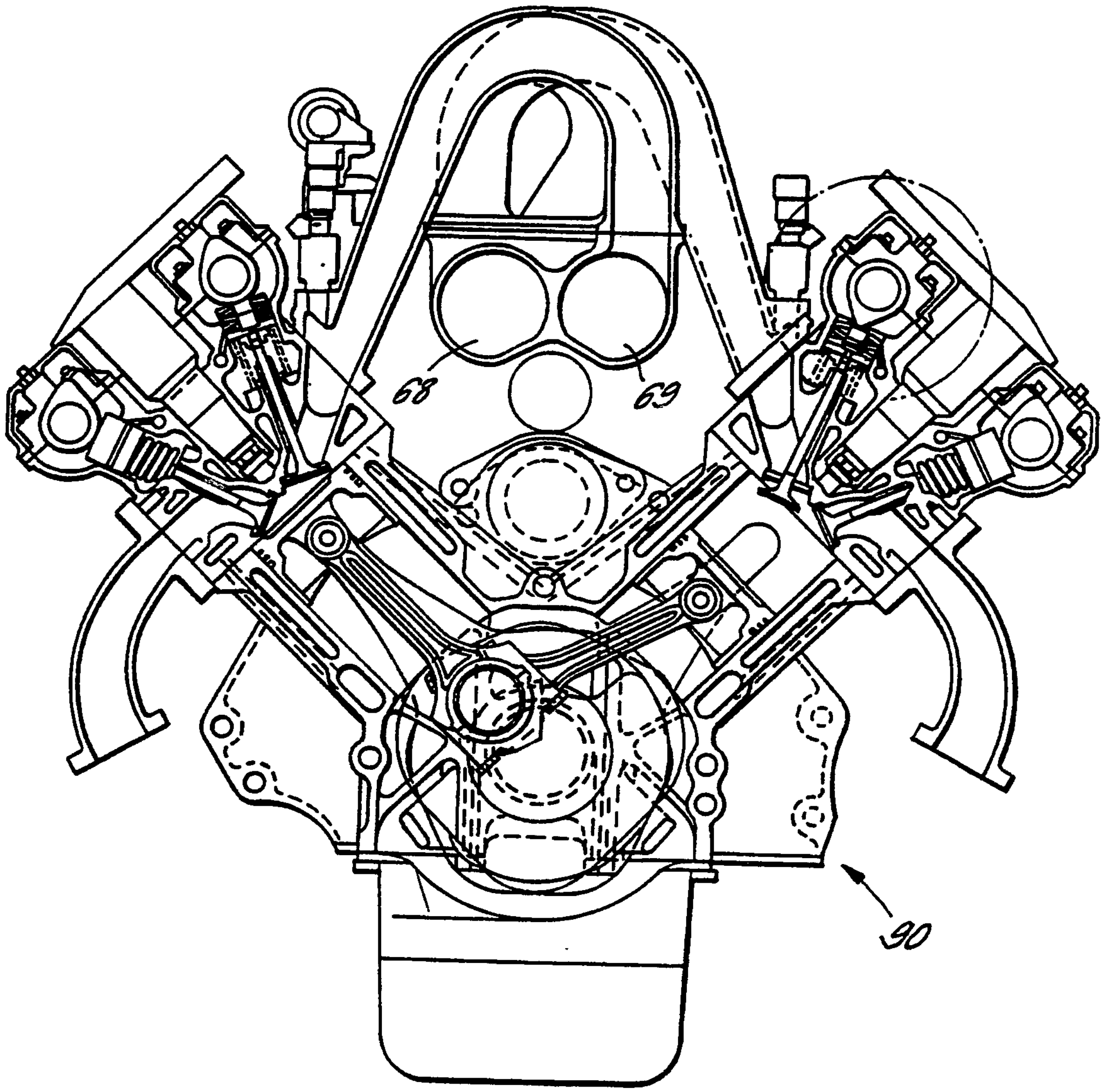
FIG. 9.



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Applicant: Deiss, et al.

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